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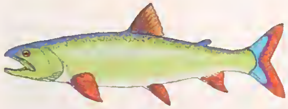
Ontario

MINISTRY OF ENVIRONMENT AND ENERGY
SCIENCE AND TECHNOLOGY BRANCH
AQUATIC SCIENCE SECTION



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LAKE SIMCOE - THE NEED FOR MAJOR REDUCTIONS IN PHOSPHORUS LOADING

Background

With a surface area of 725 km^2, Lake Simcoe is the largest lake in south-central Ontario, exclusive of the Great Lakes. It is the drinking water source for four municipalities and receives treated wastewaters from 14 sewage treatment facilities. The lake is a tremendously valuable resource; it is within one hour's drive for half of the population of Ontario. Approximately $500 million is spent annually on tourism and recreational activities in the Lake Simcoe basin. An estimated one million angler-hours per year is spent on the lake. Lake Simcoe and many of its river valleys are important natural heritage features in the Ontario landscape. A healthy Lake Simcoe contributes significantly to the Ontario economy and the physical and spiritual health of hundreds of thousands of people. The human population in the Lake Simcoe basin has grown exponentially since the 1940s and the 1991 population of about 280,000 was twice as high as the 1971 population.

The Problem

As a result of a long history of nutrient loading to the lake from agricultural activities and urbanization, water quality has deteriorated appreciably. Municipal water treatment facilities now experience clogging of filters from Lake Simcoe algae. Turbid water and masses of dead and decomposing vegetation characterize some parts of the lake during late summer and fall.

Dissolved oxygen in the deep-water zones of the lake are depleted to levels that are lethal to cold-water fish like lake trout, lake whitefish and herring (Fig. 1). Spawning shoals are covered with algae (Fig. 2). The lake no longer supports a self-reproducing lake trout population. Lake trout and lake whitefish stocks are maintained by the Ministry of Natural Resources through a massive annual stocking of fingerlings of these species.

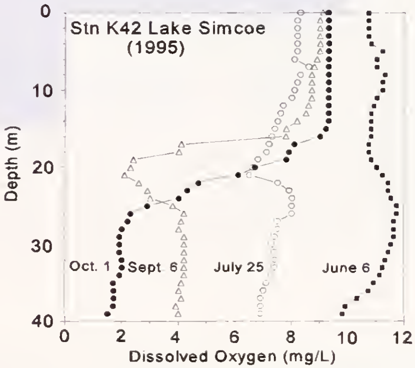

Figure 1 Loss of dissolved oxygen in the bottom waters of Lake Simcoe during the summer-fall period of 1995.

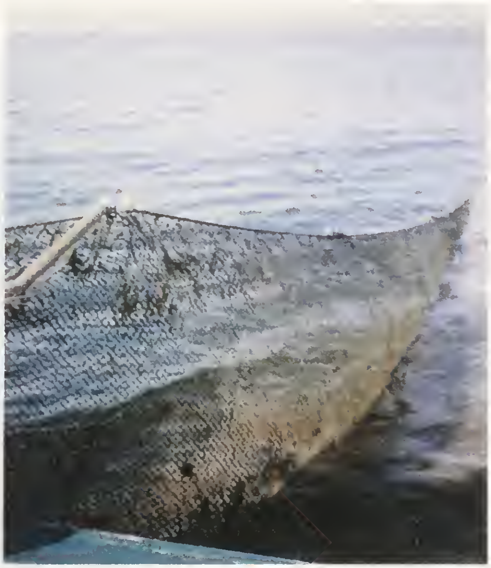

Figure 2 Accumulation of algae on a Ministry of Natural Resources trap net after one week's exposure on a Lake Simcoe lake trout spawning shoal in October 1995.

The principal cause of this deteriorated state is excessive phosphorus loading, estimated at about 100 metric tons per year for the late 1980s-early 1990s. The most important sources are agriculture and urban runoff (Fig. 3). Under Phase I of the LSEMS Programme (Lake Simcoe Environmental Management Strategy), phosphorus loading to the lake was decreased by about 14 metric tons/year through changes in agricultural practices and improved sewage treatment. However, the effects were largely undone by continued population growth and increased phosphorus loading from urban runoff.

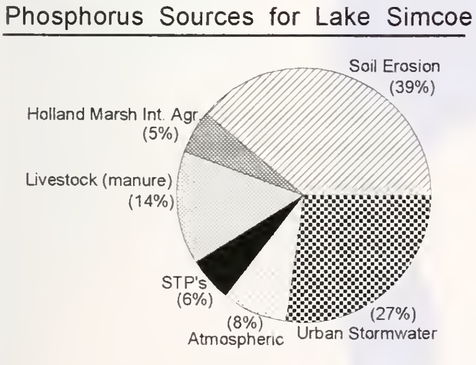

Figure 3 The most important sources of phosphorus loading to Lake Simcoe during the late 1980s - early 1990s.

The Solution

The LSEMS Programme released a comprehensive set of recommendations for Phase II, for which Provincial Cabinet endorsement was given in February of 1995. The Goal of the LSEMS programme is "**to re-establish a naturally reproducing coldwater fish community in Lake Simcoe**". The restoration of water quality is vital to the attainment of this goal and remains the primary objective of Phase II of the LSEMS Programme.

Based on information stored in the lake sediments on phosphorus concentrations and mass sedimentation rates over time, a pre-1800's phosphorus loading rate of about 32 metric tons has been determined. Two independent approaches to oxygen-phosphorus modelling have hindcast an end-of-summer dissolved oxygen concentration of about 8 mg/L for circa 1800 AD (i.e., optimal lake trout habitat existed pre European "invasion"). A reduction in phosphorus loading of about 25% will be required to achieve an increase in the end-of-summer deep-water oxygen to 5 mg/L from present-day concentrations of only 3-3.5 mg/L (Fig. 4).

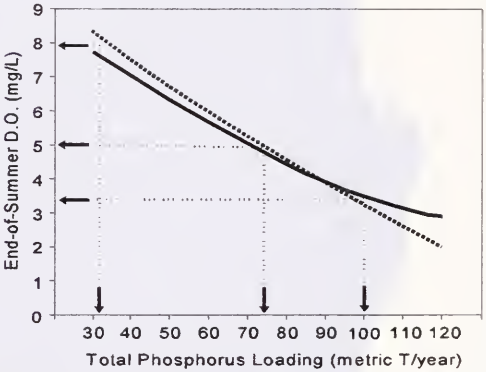

Figure 4 The predicted end-of-summer volume-weighted dissolved oxygen concentrations in the deep-water zone (18 m-bottom) in Lake Simcoe over a range of phosphorus loading from 30 to 120 metric tons per year. The dashed and solid lines are independent predictions from empirical and deterministic models, respectively. Arrows indicate the present-day loading rate (100 T/y), a projected loading rate of about 73 T/y required to achieve an end-of-summer- dissolved oxygen concentration of 5 mg/L, and a hindcast end-of-summer concentration of about 8 mg/L resulting from a pre-settlement loading rate of 32 T/y.

LSEMS is one of Ontario's finest examples of partnerships for environmental stewardship. The list of collaborators includes OMAFRA, MOEE, MNR, LSRCA, the SOS Alliance, 17 municipalities and many farmers. Still, a further reduction of 25% in phosphorus loading will be difficult to achieve in the absence of capital incentive programmes such as CURB, Land Stewardship

and OSCEPAP for which funding has ended. An important objective of Phase II of LSEMS will therefore be to find new ways of partnering stakeholder and special interest groups in the Lake Simcoe basin so that measurable progress can be made towards the 25% reduction in phosphorus loading over the five year term of Phase II.

The most frequently asked question by the public is "**... is the lake getting better?...**". It is possible to answer this question as long as assessments of water quality and biological communities are continuing to generate trend data. Phosphorus loading-lake water quality relationships have been complicated by the recent invasions of black crappie, zebra mussels and the spiny water flea. A thorough understanding of biological/limnological interactions will be necessary for future interpretation of time series data. At the very minimum, the Aquatic Science Section's responsibilities to Phase II of LSEMS will include refinement of phosphorus and related contaminant loadings to Lake Simcoe and measurement of trends in the lake and inflowing streams and rivers.

Further Information

Province of Ontario and LSRCA. 1995. Lake Simcoe - Our Waters, Our Heritage. Lake Simcoe Environmental Management Strategy Implementation Program. Summary of Phase I Progress and Recommendations for Phase II. Lake Simcoe Region Conservation Authority, Newmarket, Ontario. 109 p.

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